

of the blastopore before the closing of the primitive streak region, or, to this area minus the secondary extension, caused by the projecting yolk, in Monotremata.

IV. "On the Total Solar Eclipse of August 29, 1886 (Preliminary Account)." By ARTHUR SCHUSTER, Ph.D., F.R.S., Professor of Applied Mathematics in Owens College, Manchester. Received March 3, 1887.

The instrument entrusted to me by the Eclipse Expedition was similar to that employed in Egypt during the eclipse of 1882. The equatoreal stand carried three cameras, one of which was intended for direct photographs of the corona, while the two others were attached to spectroscopes.

*Photographs of the Corona.*—The lens had an aperture of 4 inches, and a focal length of 5 feet 3 inches; giving images of the moon having a diameter of about 0·6 of an inch.

During the first minute of totality the corona was covered by a cloud, which was, however, sufficiently transparent to allow the brightest parts of the corona to show on the two photographs exposed during that time.

During the remaining time, that is to say, during about two minutes and a half, the sky was clear, but there were clouds in the neighbourhood of the sun.

The time of exposing the photographs, which had been fixed beforehand, had to be altered in consequence of the uncertainty of the weather, and for this reason I can only give the actual times of exposures very approximately and from memory. One photograph on sensitive paper shows only little detail; but three photographs on glass were obtained, which, as regards definition, I believe to be equal to those obtained in Egypt. The approximate exposures were 15 to 20 seconds, 10 to 15 seconds, and about 5 seconds.

With the view of possibly increasing the amount of detail, which it has hitherto been possible to obtain on the photographs of the corona, I have, on this occasion, given considerable attention to the different adjustments, so as to fix the cause which at present limits the definition. A telescope of 4 inches aperture ought to separate two small objects which are at an angular distance of about 6 seconds of arc. The theoretical resolving power can only be realised with small and distinct objects like double stars; in an object like the corona it is difficult to estimate the resolving power actually obtained. Nevertheless, as far as I can judge, the photographs obtained in Egypt and in Grenada with the same instrument show no detail which theoretically could not have been seen with an aperture of 1 inch. The photo-

graphs obtained in India during the eclipse of 1871 show about the same fineness of detail as those obtained in 1882 and 1886, but the aperture then employed was only 2 inches. It appears from this either that the corona does not as a rule show sufficient detail to warrant an aperture greater than 2 inches, or that for some other reason the full advantage of an aperture of 4 inches has not been realised.

A linear object having an angular magnitude of 6 seconds of arc in a camera of 63 inches focal length would have a length of about the 600th part of an inch in the photographic plate. Remembering the fact that diffraction gratings have been photographed with 17,000 lines to the inch, it is clear that it cannot be the fault of the photographic film if greater definition is not obtained.

The different adjustments which it is in the power of the observer to regulate can all be easily made to the required accuracy. I feel certain, at any rate, that during the last eclipse the orientation of the instrument and the average rate at which the clock went during the eclipse were sufficient to give the theoretical resolving power. There seems to me to be only one way in which an improvement in the photographs can be hoped for. The mechanical arrangement by means of which the clock motion is transferred to the camera is far from perfect. The series of cogged wheels which transmit the motion must do so, in my opinion, in an irregular and oscillatory manner, so that although the average rate of the clock can be regulated with sufficient accuracy, there are minor periods which seriously interfere with the regularity of the motion and the definition of the images. If we are to obtain better photographs of the corona we can only hope to do so by means of a better mechanical arrangement for moving the camera.

*Photographs of the Spectrum* of the corona were obtained by means of two instruments, one being identical with that employed at Caroline Island in 1883. This spectroscope has two prisms of 62° refracting angle, the theoretical resolving power being about 10 in the yellow. (The unit of resolving power is that resolving power which allows of the separation of two lines differing by the thousandth part of their own wave-length.) The slit of this spectroscope was placed so that it was tangential to the image of the sun formed by the condensing lens. One plate was exposed during the whole of totality. The results are good; a number of lines belonging to the prominences and to the corona are very distinct and can be measured with fair accuracy. The difficulty of measurement lies in the multitude of lines. I have measured at present between forty and fifty distinct corona lines between the solar lines F and H, and a number remain unmeasured.

A comparison between the photographs of 1882 and 1886 shows

that although the lines seem to be in the same position their relative intensity has greatly altered. The strongest corona line during the last eclipse had a wave-length of about 4232; it is slightly but distinctly less refrangible than the strong calcium line at 4226.

The measurement of the photographs is very fatiguing to the eyes; and it is only when these are in exceptionally good condition that the work can be done with any degree of accuracy. The delay in bringing out a full report is solely due to this difficulty.

The second spectroscope had its slit placed so as to take a radial section of the corona. It had one large prism giving a theoretical resolving power of 11·4; slightly larger therefore than the two-prism spectroscope.

The film was one prepared by Captain Abney so as to be more sensitive in the green than the ordinary plates.

The photograph obtained is faint, but I believe will ultimately give good results.

A good drawing of the corona was obtained by Captain Maling at the station occupied by Captain Darwin and myself.

The plates were prepared by Captain Abney, whose valuable help I have had in the whole of the preliminary arrangements.

*Presents, March 17, 1887.*

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